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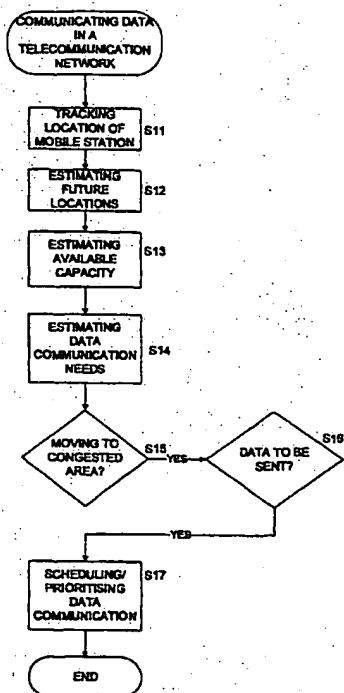
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(54) Title: PRIORITIZED SENDING OF DATA



(57) Abstract: According to the present invention, a method and a system for communicating data in a telecommunication network (3) in which the available capacity is not uniformly distributed is disclosed. The system comprises control means (2) for tracking the locations of a mobile station (1) moving in the telecommunication network (3), and for scheduling the data communication to or from the mobile station in accordance with the current capacity of the network and the predicted future capacity.

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TITLE OF THE INVENTION

Prioritized sending of data.

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FIELD OF THE INVENTION

The present invention relates to a method and a system for communicating data in a cellular telecommunication network.

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BACKGROUND OF THE INVENTION

According to cellular network systems, the entire area of coverage is divided into contiguous or overlapping cells having a size up to several kilometers depending on the anticipated traffic load. Each cell comprises a base station with a certain communication capacity or throughput capacity. Neighbouring cells use different frequencies, although cells that are further apart can use the same frequencies as they are not hindered by each other due to the relatively low power of all the transmitting stations used. Alternatively, some radio technologies like CDMA (Code Division Multiple Access) systems can use the same frequency in neighbouring or overlapping cells.

25

Different types of cells can be handled in the same geographical environment in a limited bandwidth. For example, there may be two different overlapping cell layers in one geographical region, which layers consist of micro cells and macro cells, respectively.

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When a mobile station (MS) moves in such a cellular network while communicating via this network, handovers between cells in an area of the network have to take place. Moreover, while moving in the cellular network, the mobile station may move to a congested area consisting of at least one congested

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cell. In congested areas, however, the Quality of Service (QoS) offered to the mobile station may have to be reduced.

SUMMARY OF THE INVENTION

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It is therefore an object of the present invention to enable reliable and optimized data communication in telecommunication networks having congested areas.

- 10 According to a first aspect of the present invention, this object is achieved by a method for communicating data in a telecommunication network in which the available capacity is not uniformly distributed, comprising the steps of:

tracking the locations of a mobile station moving in the
15 telecommunication network; and

scheduling the data communication to or from the mobile station in accordance with the available capacity of the network.

- 20 According to a second aspect of the present invention, the above-mentioned object is achieved by a telecommunication system for communicating data in a telecommunication network in which the available capacity is not uniformly distributed, comprising:

25 control means for tracking the locations of a mobile station moving in the telecommunication network, and for scheduling the data communication to or from the mobile station in accordance with the available capacity of the network.

30

The scheduling can be performed on the basis of the available capacity of the network at the current location and/or future locations of the mobile station

- 35 The control means may estimate the future locations of the mobile station on the basis of the tracked locations.

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Furthermore, the control means may estimate the future locations of the mobile station on the basis of route information about the moving mobile station provided by the
5 mobile station.

The future locations of the mobile station can also be estimated on the basis of movement patterns of the mobile station.

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Moreover, the control means may estimate the available capacity of the network at the current and future locations of the mobile station on the basis of an estimated current and/or future traffic load distribution of the network in the
15 area in which and/or towards the mobile station is moving.

The area may comprise cells, groups of cells, geographical areas and network nodes.

20 In addition, the control means estimate the data communication needs of the mobile station.

The data communication to or from the mobile station may be prioritized by the control means when the data communication
25 needs exceed a specific amount of data to be communicated.

Moreover, the data communication to or from the mobile station at the current location of the mobile station may be prioritized by the control means when the available capacity
30 at future locations is less than that at the current location.

In contrast thereto, the data communication to or from the mobile station at the current location of the mobile station
35 may be delayed by the control means when the available

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capacity at future locations is higher than that at the current location.

The mobile station may execute measurements of the traffic load distribution in the area and along the path in which it is moving, wherein the control means estimate the available capacity of the current and future locations of the mobile station on the basis of the measurement results transmitted from the mobile station to the control means.

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Furthermore, the control means may monitor buffers for buffering data transmitted to and from the mobile station, and estimate the data communication needs of the mobile station on the basis of the monitored amount of buffered data.

15

The control means may also estimate the data communication needs of the mobile station on the basis of a transmission request from the mobile station.

20

The mobile station may execute the measurements according to traffic load distribution information received from the network.

In addition, a plurality of mobile stations each having data communication needs may be present in the network, wherein the data communications of the plurality of mobile stations are scheduled in accordance with the available capacity of the network.

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The data communications of the plurality of mobile stations can also be scheduled in accordance with estimated data communication needs of these mobile stations.

According to the present invention, the Quality of Service provided for a mobile station communicating a significant

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amount of data can be maintained even if the mobile station moves in a network in which the available capacity is not uniformly distributed.

- 5 Furthermore, according to the present invention, network resources and radio efficiency can be optimized.

Moreover, according to the present invention, network capacities can be reserved for the users.

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In the following the present invention will be described by way of a preferred embodiment thereof with reference to the accompanying drawings.

15 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a schematic block diagram of a communication system according to an embodiment of the present invention.

- 20 Fig. 2 shows a flow chart of an operation of control means according to the embodiment of the present invention.

Fig. 3 shows a flow chart of a more detailed operation of the control means according to the present invention.

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DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 shows a schematic block diagram of a communication system according to an embodiment of the present invention.

- 30 As it is illustrated in Fig. 1, a mobile station 1 is connected to a network 3, and control means 2 communicate with the mobile station 1 and the network 3.

In Fig. 1, the control means 2 are shown as being located
35 between the mobile station 1 and the network 3. However, the control means can also be partially or fully included in the

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network 3. Moreover, parts of the control means also can be incorporated in the mobile station 1.

The network 3 may be a cellular network formed of contiguous or overlapping cells, in which the available capacity is not uniformly distributed. There may be cells of different sizes, each grouped in layers, for example a macro layer consisting of macro cells and a micro layer consisting of micro cells within a macro cell.

10

When the mobile station 1 moves in the network, the cell that is serving the mobile station may change.

Moreover, when the mobile station 1 encounters a congested area in the network 3 which is formed of at least one cell having a traffic load which is expected to be above a predetermined threshold, the Quality of Service (QoS) provided for the mobile station 1 may have to be reduced.

20 It is noted, that an area in the network can comprise cells, groups of cells, geographical areas or network nodes.

In case data communication has to be performed by the mobile station 1 via the network 3 while the mobile station 1 is moving in the network having non-uniformly distributed available capacity, measures have to be taken in order to provide a reliable and optimized data transmission and reception by the mobile station 1.

30 According to the present invention, the control means 2 operate to provide a reliable and optimized data communication in the network 3. The operation of the control means 2 will be described in the following with respect to the flow charts shown in Figs. 2 and 3.

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According to the embodiment of the present invention shown in Fig. 2, the control means 2 keep track of the locations of the mobile station 1 moving in the network 3 (step S1). In case the control means 2 estimate that the mobile station is going to move to or enter a congested area in the network 3 (step S2), i.e. an area where the available capacity is decreased, and that there are data to be sent or received by the mobile station (step S3) the control means 3 prioritize the data communication to or from the mobile station 1 (step S4).

Alternatively, if the control means estimate that the mobile station is going to move to a less congested area it delays the data transmission or reception of the mobile station.

15

Fig. 3 shows a more detailed operation of the control means. According to Fig. 3, the control means 2 keep track of the locations of the mobile station 1 as it moves in the network 3 (step S11). In other words, the control means 2 always can estimate the location of the mobile station 1. In addition, the control means 2 estimate the moving direction or future locations and/or the velocity of the mobile station (step S12) on the basis of the tracked locations. Moreover, the future locations of the mobile station 1 can also be estimated on the basis of route information stored in the network 3. The route information comprises map information such as the road on which a user operating the mobile station is traveling or information about movement patterns of users or this specific user. In addition, the mobile station may be able to inform the network 3 or the control means 2 about its movement pattern either automatically or the subscriber will decide when the procedure will be started.

The control means 2 estimate the traffic load distribution in the vicinity of the mobile station and/or along the path on which the mobile station is moving (step S13). This can be

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done for example by evaluating a traffic load distribution present in the network 3. Furthermore, the mobile station 1 can execute measurements of the traffic load distribution in its vicinity and can inform the control means 2 about these
5 measurements. The mobile station 1 can perform these measurements on the basis of traffic load distribution information provided by the network 3. Then, the control means 2 can use these measurements for estimating the available capacity of the network in the vicinity of the
10 actual location of the mobile station.

The traffic load distribution can for example be measured on a cell-to-cell basis.

15 Furthermore, the control means 2 estimate data communication needs offered by the mobile station 1 (step S14). This estimation is made by checking buffers for buffering data transmitted to or from the mobile station 1 or by checking whether the mobile station 1 has indicated data communication
20 needs. The estimation also can be based on previous data communication requirements or previous data communications and type of connection of the mobile station.

When the control means 2 estimate on the basis of the
25 estimated moving direction or future locations and/or velocity of the mobile station 1 and on the basis of the estimated traffic load of a neighboring area that it is very likely that the mobile station 1 is moving towards or enters a congested area (step S15), and when the control means
30 estimate that there are data communication needs of the mobile station, i.e. that the mobile station will transmit or receive data very soon (step S16), by detecting the state of buffers in the control means or an indicated data communication need, the control means 2 schedule the traffic
35 to or from the mobile station 1 by giving the traffic to or from the mobile station 1 a priority, while the mobile

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station 1 is still in a less congested area of the network 3 (step S17).

The control means 2 can also instruct the mobile station 1 to
5 perform the data communication quickly before entering the congested area.

Alternatively, the control means 2 can delay the data communication to or from the mobile station 1 in case it
10 estimates that the mobile station 1 is going to enter a less congested area, i.e. an area having more capacity available than that area in which the mobile station is currently present.

15 The priority given to the mobile station 1 by the control means 2 may for example depend on the mobile or connection class of the mobile station 1 or the type of subscription.

The control means 2 are able to estimate a probability with
20 which or when the mobile station is going to enter a congested area. That is, the control means 2 can estimate a probability with respect to movements of a subscriber. Moreover, the control means 2 are able to estimate relative or absolute changes in the available capacity, i.e. a
25 probability of congestion in the network 3. If the estimated probability with respect to the movement of the subscriber or mobile station 1 exceeds a predetermined threshold and/or the relative or absolute change in the available capacity exceeds a threshold, the control means 2 may prioritize the data
30 communication to or from the mobile station 1. These thresholds may be fixed or dynamic thresholds and may for example depend on network conditions. For example, the thresholds may be set in accordance with relative or absolute changes of the available capacity.

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- 10 -

For example, according to a GPRS (General Packet Radio Service) network system, the control means 2 combine the features of a Serving GPRS Support Node (SGSN) and a Base Station Controller (BSC).

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According to this example, the mobile station 1 connects to the network 3 via a Base Station System (BSS) comprising the BSC, which communicates with the SGSN.

- 10 The SGSN is able to track the location of the mobile station 1. The BSC which comprises buffers for buffering data transmitted to or from the mobile station 1 is able to estimate data communication needs of the mobile station 1 by monitoring filling conditions of its buffers. Moreover, the
- 15 mobile station 1 executes measurements of neighbouring cells and the BSC can derive from these measurements whether the mobile station 1 is close to a congested cell or area. The BSC communicates the information about the data communication needs of the mobile station 1 and the moving direction and/or
- 20 velocity of the mobile station 1 to the SGSN which knows the Quality of Service provided for the mobile station 1 and is able to prioritize or schedule the traffic to or from the mobile station 1.

- 25 The present invention is also applicable in the field of High Speed Circuit Switched Data (HSCSD) systems, UMTS (Universal Mobile Telecommunications System), BRAN (Broadband Radio Access Networks) and satellite communication systems.

- 30 In particular, the present invention is applicable to systems in which the user is stationary and is subjected to network location and capacity changes.

- According to the present invention, the Quality of Service
- 35 provided for a mobile station communicating a significant amount of data can be maintained even if the mobile station

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moves in a network in which the available capacity is not uniformly distributed.

Furthermore, according to the present invention, network
5 resources and radio efficiency can be optimized.

While the invention has been described with reference to a preferred embodiment, the description is illustrative of the invention and is not to be construed as limiting the
10 invention. Various modifications and applications may occur to those skilled in the art without departing from the true spirit and scope of the invention as defined by the appended claims.

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CLAIMS:

1. A method for communicating data in a telecommunication network (3) in which the available capacity is not uniformly distributed, comprising the steps of:
 - tracking (S1) the locations of a mobile station (1) moving in the telecommunication network (3); and
 - scheduling (S4) the data communication to or from the mobile station (1) in accordance with the available capacity of the network.
2. The method according to claim 1, wherein the data communication to or from the mobile station is scheduled in accordance with the available capacity of the network at the current and/or future locations of the mobile station.
3. The method according to claim 2, comprising the further step of:
 - estimating (S12) the future locations of the mobile station on the basis of the locations tracked in the tracking step (S1).
4. The method according to claim 2, comprising the further step of:
 - estimating (S12) the future locations of the mobile station on the basis of route information about the moving mobile station provided by the mobile station.
5. The method according to claim 2, comprising the further step of:
 - estimating (S12) the future locations of the mobile station on the basis of movement patterns of the mobile station.
6. The method according to claim 2, comprising the further step of:

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estimating (S13) the available capacity of the network at the current and future locations of the mobile station on the basis of an estimated current and/or future traffic load distribution of the network in the area in which and/or
5 towards the mobile station is moving.

7. The method according to claim 6, wherein the area comprises cells, groups of cells, geographical areas and network nodes.

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8. The method according to claim 1, comprising the further step of:

estimating (S3) the data communication needs of the mobile station.

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9. The method according to claim 8, wherein the data communication to or from the mobile station is prioritized in the scheduling step when the data communication needs exceed a specific amount of data to be communicated.

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10. The method according to claim 2, wherein the data communication to or from the mobile station at the current location of the mobile station is prioritized in the scheduling step when the available capacity at future
25 locations is less than that at the current location.

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11. The method according to claim 2, wherein the data communication to or from the mobile station at the current location of the mobile station is delayed in the scheduling
30 step when the available capacity at future locations is higher than that at the current location.

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12. The method according to claim 6, wherein the mobile station executes measurements of the traffic load
35 distribution in the area and along the path in which it is moving, and wherein the available capacity of the current and

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future locations of the mobile station is estimated on the basis of the measurement results.

13. The method according to claim 8, comprising the further
5 step of:

buffering data transmitted to and from the mobile station (1), wherein the estimation of the data communication needs of the mobile station (1) is performed by monitoring the amount of buffered data.

10

14. The method according to claim 8, wherein the data communication needs of the mobile station are estimated on the basis of a transmission request from the mobile station.

15 15. The method according to claim 12, wherein the mobile station executes the measurements according to traffic load distribution information received from the network.

16. The method according to claim 1, wherein a plurality of
20 mobile stations each having data communication needs are present in the network, and wherein the data communications of the plurality of mobile stations are scheduled in accordance with the available capacity of the network.

25 17. The method according to claim 16, wherein the data communications of the plurality of mobile stations are scheduled in accordance with estimated data communication needs of these mobile stations.

30 18. A telecommunication system for communicating data in a telecommunication network (3) in which the available capacity is not uniformly distributed, comprising:

control means (2) for tracking the locations of a mobile station (1) moving in the telecommunication network (3), and
35 for scheduling the data communication to or from the mobile

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station in accordance with the available capacity of the network.

19. The system according to claim 18, wherein the control
5 means schedules the data communication to or from the mobile station in accordance with the available capacity of the network at the current and/or future locations of the mobile station.

10 20. The system according to claim 19, wherein the control means estimate the future locations of the mobile station on the basis of the tracked locations.

21. The system according to claim 19, wherein the control
15 means estimate the future locations of the mobile station on the basis of route information about the moving mobile station provided by the mobile station.

22. The system according to claim 19, wherein the control
20 means estimate the future locations of the mobile station on the basis of movement patterns of the mobile station.

23. The system according to claim 19, wherein the control
25 means estimate the available capacity of the network at the current and future locations of the mobile station on the basis of an estimated current and/or future traffic load distribution of the network in the area in which and/or towards the mobile station is moving.

30 24. The system according to claim 23, wherein the area comprises cells, groups of cells, geographical areas and network nodes.

25. The system according to claim 18, wherein the control
35 means estimate the data communication needs of the mobile station.

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26. The system according to claim 25, wherein the data communication to or from the mobile station is prioritized by the control means when the data communication needs exceed a
5 specific amount of data to be communicated.

27. The system according to claim 19, wherein the data communication to or from the mobile station at the current location of the mobile station is prioritized by the control
10 means when the available capacity at future locations is less than that at the current location.

28. The system according to claim 19, wherein the data communication to or from the mobile station at the current
15 location of the mobile station is delayed by the control means when the available capacity at future locations is higher than that at the current location.

29. The system according to claim 23, wherein the mobile
20 station executes measurements of the traffic load distribution in the area and along the path in which it is moving, and wherein the control means estimate the available capacity of the current and future locations of the mobile station on the basis of the measurement results transmitted
25 from the mobile station to the control means.

30. The system according to claim 25, wherein the control means monitor buffers for buffering data transmitted to and from the mobile station (1), and estimate the data
30 communication needs of the mobile station (1) on the basis of the monitored amount of buffered data.

31. The system according to claim 25, wherein the control means estimate the data communication needs of the mobile
35 station on the basis of a transmission request from the mobile station.

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32. The system according to claim 29, wherein the mobile station executes the measurements according to traffic load distribution information received from the network.

5

33. The system according to claim 18, wherein a plurality of mobile stations each having data communication needs are present in the network, and wherein the data communications of the plurality of mobile stations are scheduled in accordance with the available capacity of the network.

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34. The system according to claim 33, wherein the data communications of the plurality of mobile stations are scheduled in accordance with estimated data communication needs of these mobile stations.

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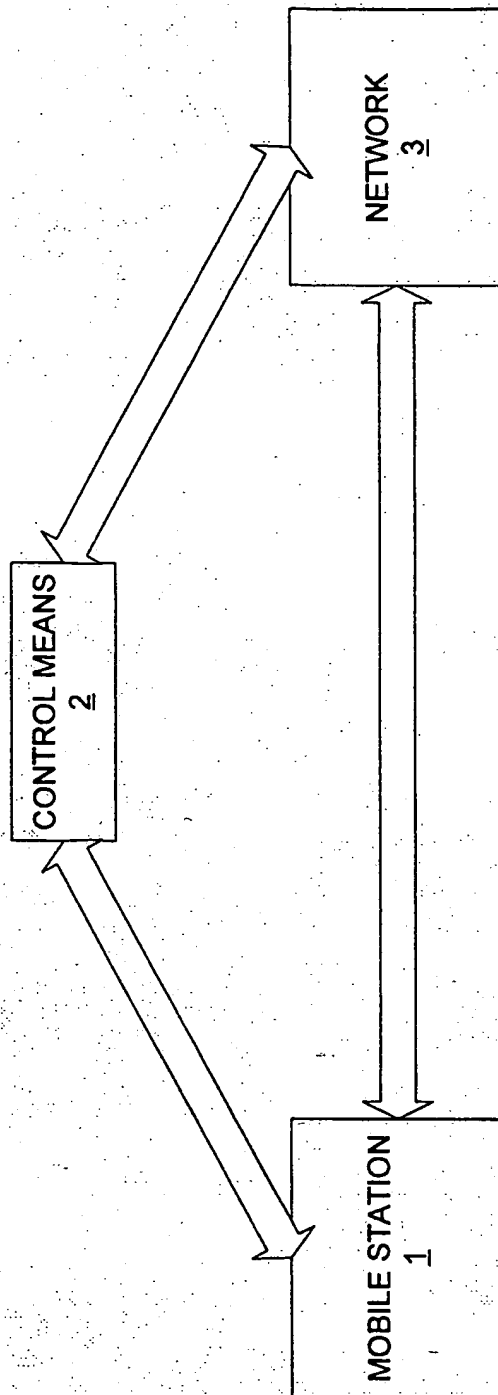


FIG. 1

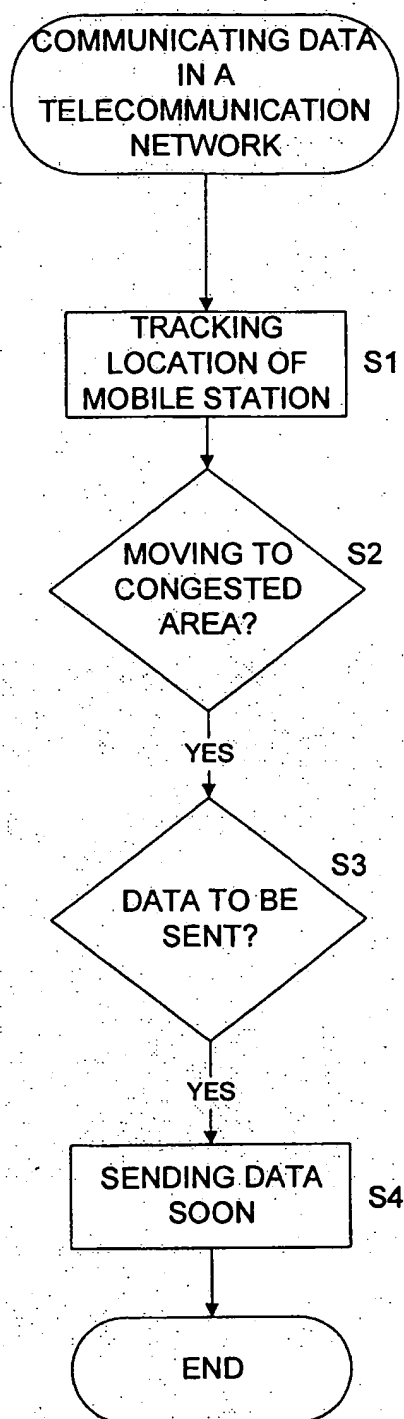


FIG. 2

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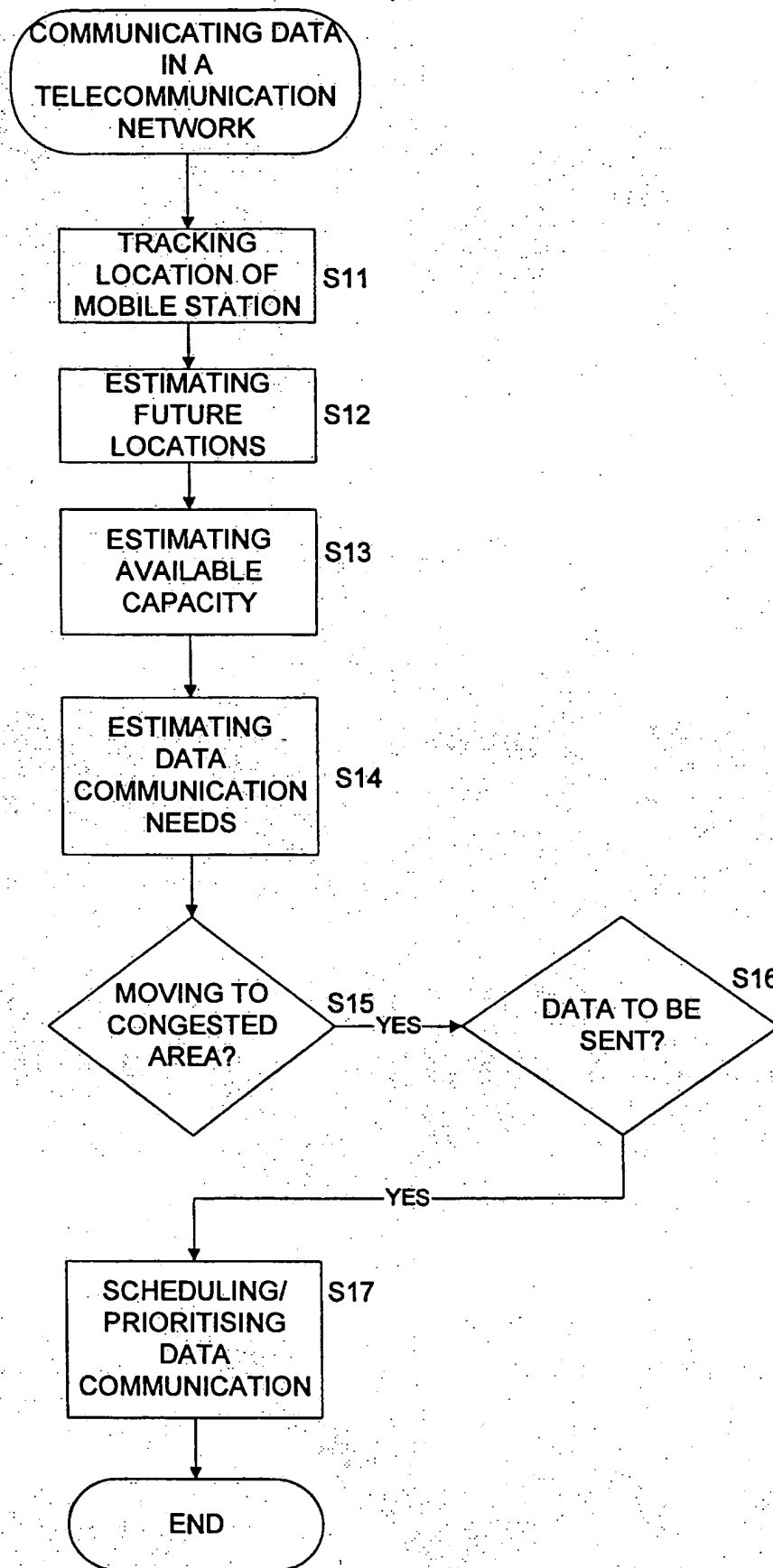


FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/EP 99/04981

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>WO 98 35514 A (QUALCOMM INC) 13 August 1998 (1998-08-13)</p> <p>page 6, line 4 -page 8, line 2 page 11, line 37 -page 14, line 2 page 15, line 35 -page 18, line 8 page 53, line 1 -page 55, line 31</p>	<p>1,2,8,9, 13,14, 16-19, 25,26, 30,31, 33,34</p>
A	<p>WO 98 45966 A (QUALCOMM INC) 15 October 1998 (1998-10-15)</p>	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Int. Appl. No.

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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